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NOTES ON THE HABITS OF TWO ARKANSAS SALAMANDERS AND A LIST OF BATRACHIANS AND REPTILES COLLECTED AT HOT SPRINGS.

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During the years 1894, 1895 and 1896 I received nearly 250 batrachians and reptiles from Hot Springs, Arkansas. These specimens were collected by my friend, Bert Lawrence Combs, who was killed at Red Oak, Iowa, in the spring of 1897, by a fall from a tree. Young Combs, who was only twenty years of age when he met his untimely end, was an enthusiastic ornithologist, and had he lived might have become eminent in his particular field of science. To his energy, intelligence and generosity I am indebted for many specimens and valuable notes. At his death, in fulfillment of a wish he had expressed several years before, I became the possessor of his books and collection of specimens. A loving, generous soul, may he rest in peace.

The Hot Springs specimens collected by Combs were an interesting lot. They represented 36 species and subspecies, including the types of the salamander described by Dr. Stejneger under the name of *Desmognathus brimleyorum* and four of the five known specimens of the rare *Ambystoma annulatum* Cope.

In this paper I have incorporated his most interesting observations; and give a complete list of the species received from him with my personal comment thereon.

Ambystoma annulatum Cope.

COMBS' SALAMANDER.

Cope described this species under the name of *Linguelapsus annulatus*, from a specimen in the United States National Museum collection. The

type (No. 11,564) was unlabeled and its habitat remained unknown until Combs collected his first specimen in the month of October, 1894. This specimen was presented to me and I disposed of it, through exchange, to Mr. C. S. Brimley. Mr. Brimley sent it to Washington and it is now in the National collection.

Regarding this specimen, Dr. Stejneger made the following comments: "A direct comparison with the type specimen shows the peculiar coloration to be identical, with the trifling exception that in the type the light crossband from arm to arm is interrupted in the middle of the back, while in the new specimen it is continuous like the other crossbands. A pale crossband between the eyes, not mentioned by Prof. Cope, is present in both specimens. The new specimen is comparatively fresh and the ground color appears to have been black, the crossbands silver-gray."*

The other three specimens were sent to me alive. They were the most beautiful salamanders I have ever seen, and I have examined specimens of nearly all of our eastern North American forms. The ground color was shiny black and in two of the specimens all of the crossbands were of a deep sulphur-yellow. In the third example (the female) the anterior bands were yellow, the posterior ones almost white.

The following notes on the capture and breeding habits of this interesting species I am quoting from the letters and field notes of the collector:

"Near the city is a creek which is dry during some seasons but runs in wet weather. At a certain point, about a yard from this creek and lying at the foot of a sweet-gum tree, is a log about ten feet in length. This log is partly imbedded in the mud, very much decayed, and when I first visited it, was almost covered by pine-needles. Under it are large holes made by crayfish. On turning the log over I found the salamander and a king snake." (Oct., 1894. Letter.)

"A couple of days ago I found a second black and yellow salamander in the same place as the last. It was dead and in an advanced stage of decomposition." (Nov., 1894. Letter.)

"I hunted for further specimens of this fine salamander, without success, until the following spring. One night in March we had a severe rainstorm. The next morning, as soon as the sun came out, I made a trip to my log, and on turning it over there lay two of the much-desired batrachians. On my looking closer I could see that one of the two had been depositing some eggs. There were thirty-five of these eggs so far and she continued to deposit more, as she crawled leisurely on, with the male closely following and inspecting each one as it was deposited. The eggs were placed about an eighth of an inch apart. By this time she had almost reached one of the crayfish holes, so I quickly seized her and the male and carefully rolled the log back in place. I secured a water-tight box, filled it half full of mud and water and placed the salamanders in it and they seemed perfectly satisfied. About 4 P. M. that day I decided to take another look under the log, and on again turning it over found a third specimen. The specimens measured eight, five and a half and six inches respectively. [Length of head, body and tail. The tail in the

* Proc. U. S. Nat. Mus., 1894, p. 599.

largest example was almost twice the length of that of the six-inch specimen. At the time they were received I took measurements of the length of head and body to vent of each of the three specimens, but these records have been lost. J. K. S.] After the salamanders had been in captivity about twelve hours the female had deposited a total of 150 eggs. I kept them three days longer in order to study their habits, and found them to be stupid and sluggish. If disturbed they would lie perfectly still and make no attempt to move away, but their neighbors (*Desmognathus*) would run at the slightest alarm. On the fourth day I packed them in damp moss and forwarded them to Strecker. On the fifth day the eggs began to shrivel up, but I poured more water in the box and in a few hours they had resumed their normal condition. On the tenth day the young salamanders began to come out of the eggs. When first hatched they were only about half an inch in length and were similar to larval salamanders that I had seen in Strecker's collection. [Larvæ of *Ambystoma opacum*, from Brimley, if I remember rightly. J. K. S.] I let them remain in the box for a few hours and then released them in a moist place, not far from where I had captured the parents." (Typewritten notes dated June 25, 1895.)

Whether any of Combs' young salamanders survived or not is a question. In late years Mr. Julius Hurter has twice visited Hot Springs in quest of this species, but failed to find them on both occasions, although he was provided with my data. From the above notes, and my study of the living specimens, I have written the following conclusions:

1. Five of the six recorded specimens of *Ambystoma annulatum* Cope were found under the same log, in the woods near Hot Springs, Ark. (The five of course including the dead specimen mentioned in Combs' second letter.)

2. The coloration in the living specimen is black and yellow, instead of black and silver-gray as was suggested to Stejneger by the colors in the preserved specimen.

3. These salamanders inhabit the deserted burrows of crayfish and only come to the surface when the ground is moist.

4. They deposit their eggs on the ground, under logs or among masses of decayed wood.

5. The female keeps her eggs supplied with moisture until they are hatched. I have no doubt but what she carries them down into the ground, to the line of moisture, in exceedingly dry weather. (The question of how the young salamanders are carried into the water or whether they go into the water at all, I am unable to answer.)

6. The eggs are never in strings but are always separate, and as many as 150 may be deposited by the same female.

7. Combs has recorded the fact that his eggs hatched on the tenth day, but I presume this depends entirely upon the amount of moisture they receive.

Combs sent me a few of these eggs. They were slightly over an eighth of an inch in diameter and the embryos were well formed. (Incubation

was about 4½ days at the time they were received.) I supplied them with moisture, but for some reason they never hatched.

Desmognathus brimleyorum Stejn.

BRIMLEY'S TRITON.

The type lot of this species contained nearly forty specimens, all in a rather poor state of preservation, but Combs afterwards sent me a number of finely preserved examples.

At Little Rock Mr. Hurter found *Desmognathus brimleyorum* associated with *Spelerpes multiplicatus* Cope, but with the exception of the small colony under the *Ambystoma* log, no other species was found in company with the Hot Springs specimens. Combs' first specimens were found under the edges of flat rocks in the middle of a rather sluggish stream. Afterwards others were found under planks, logs and rocks, in damp woods in close proximity to water.

The larger specimens are dusky, almost sooty or of various shades of brown, with no distinct markings, while the young examples are typically of a very light yellowish-brown with the upper part of the tail either dull red or pinkish, and are more or less overlaid with dusky spots. Most of the specimens were collected in March, April, October and November, but occasionally a few were found in the summer.

Combs gave the following information in regard to the breeding habits of *Desmognathus brimleyorum :*

"In the latter part of August or early in September the female triton deposits her eggs, which are from 30 to 36 in number, and attached together in strings, in a crevice in the under side of a rotten log or in a mass of decaying wood near some small stream. The eggs are about an eighth of an inch in diameter. The female is much attached to her eggs and seldom goes far away from them. During a dry spell she will carry them down into her hole with her, and if it rains again before they are hatched, will again bring them to the surface."

The following is a complete list of the species and subspecies collected by Combs. Of those marked with a star I have received less than four specimens. The majority of the others were collected in large series.

BATRACHIA.

Ambystoma annulatum Cope.
Combs' salamander.

Desmognathus brimleyorum Stejn.
Brimley's triton.

Plethodon glutinosus Green.*
Viscid salamander.

Bufo lentiginosus americanus LeConte.
American toad.*

Engystoma carolinense Holbrook.
Narrow-mouthed toad.

Hyla versicolor chrysoscelis Cope.
Western tree frog.

Chorophilus occidentalis Baird and Girard.*
Western chorus frog.

Rana pipiens Schreber.
Leopard frog.

Rana catesbiana Shaw.
Bull frog.

Rana clamitans Latreille.
Spring frog.

REPTILIA.

Anolis carolinensis Cuvier.
Green lizard.
Sceloporus consobrinus Baird and Girard.
Western fence lizard.
Cnemidophorus gularis Baird and Girard.
Western lined lizard.
Liolepisma laterale Say.*
Ground lizard.
Eumeces quinquelineatus Linn.
Red-head; blue-tailed lizard.
Diadophis regalis Baird and Girard.*
Regal ring-necked snake.
Heterodon platyrhinus Latreille.*
Blowing adder.
Cyclophis aestivus Linn.*
Southern green snake.
Zamenis constrictor Linn.*
Black snake.
Lampropeltis doliatus doliatus Linn.*
Scarlet snake.
Lampropeltis getula sayi Holbrook.*
Western king snake.
Tropidonotus leberis L.
Leather snake.
Tropidonotus sipedon fasciatus L.*
Southern water snake.
Tropidonotus sipedon transversus Hallowell.*
Hallowell's water snake.
Eutaenia proxima Say.
Say's garter snake.
Eutaenia eques Reuss.*
Reuss' garter snake.
Eutaenia sirtalis parietalis Say.
Western garter snake.
Storeria dekayi Holbrook.
De Kay's brown snake.
Haldea striatula L.*
Brown snake.
Tantilla gracilis Baird and Girard.*
Graceful tantilla.
Ancistrodon contortrix L.*
Copperhead.
Ancistrodon piscivorus Lacepede.*
Cotton-mouth.
Crotalus horridus L.*
Banded rattlesnake.
Terrapene carolina triunguis Agassiz.
Box tortoise.
Pseudemys concinna Wied.
Neat turtle.
Chelydra serpentina L.*
Snapping turtle.